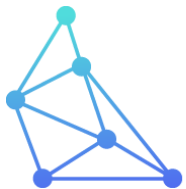




ESIG Fall Workshop – Hybrid Resources

Derek Stenclik | October 14, 2021



T E L O S E N E R G Y

HyFlex Task Force – Hybrids & Emerging Flexible Resources

ESIG System Operations & Market Design Working Group Task Force



Project Objective

Advancing the state-of-the-art understanding and experience-building for hybrid resources including plant interconnection, market rules, operation, and reliability considerations.

Key Topics for Special Sessions

1. Hybrids 101: What are they and why do we have them?
2. Transmission Interconnection & Power Flow Modeling for Hybrids
3. Market Rules and Operations for Hybrids
4. Resource Adequacy and Capacity Accreditation for Hybrids

Four special sessions, ~2 hours each, to cover each key topic; summarized in a white paper

Task Force Members

Consortium of industry leaders, developers, grid operators, utilities, researchers, & manufacturers

Project Timeline & Deliverables

Four special sessions scheduled from May – October 2021
Concluding with end of year whitepaper

Find out More

<https://www.esig.energy/hyflex-hybrids-and-emerging-flexible-resources/>

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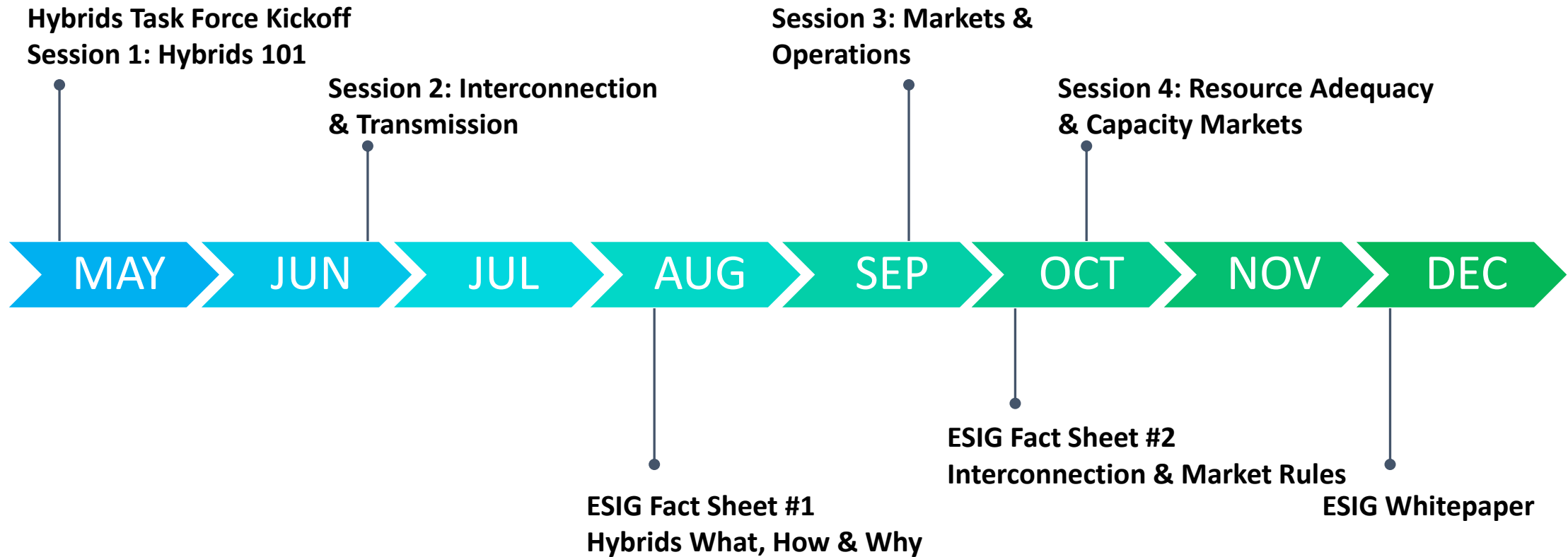
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10/15/2021

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Task Force Schedule & Deliverables



Hybrids 101: What are they and why do we have them?



Hybrid Energy Systems:

A broad universe that encompasses...

A wide variety of energy generation, storage, and conversion technologies

Generation



Storage



Conversion



The colocation and/or coordinated operations of energy technologies



Front-of-the-meter, behind-the-meter, microgrid, and off-grid applications



Systems that provide a variety of energy and non-energy products



What constitutes a hybrid? What doesn't?

- Technology?
- Fuel Type
- Controls?
- Interconnection?
- DC/AC Coupling?
- Use Case?

Objective: define hybrid resources, terms, and acronyms consistently across the industry

Source: DOE, "Hybrid Energy Systems: Opportunities for Coordinated Research," April 2021

The task force definition...

- ✓ Two or more **resources** at a single location (technology type, fuel type, storage, load)
- ✓ Located behind a single **point of interconnection**
- ✓ Include plant **controls** that coordinate the output of multiple resources to maximize value
- ✓ Operated and **coordinated** to appear as a single resource to the system operator

- ✗ Does not require storage...
- ✗ Distinct from co-located resources



Why hybrid resources?



Key drivers and decisions to hybridize

Most
Important

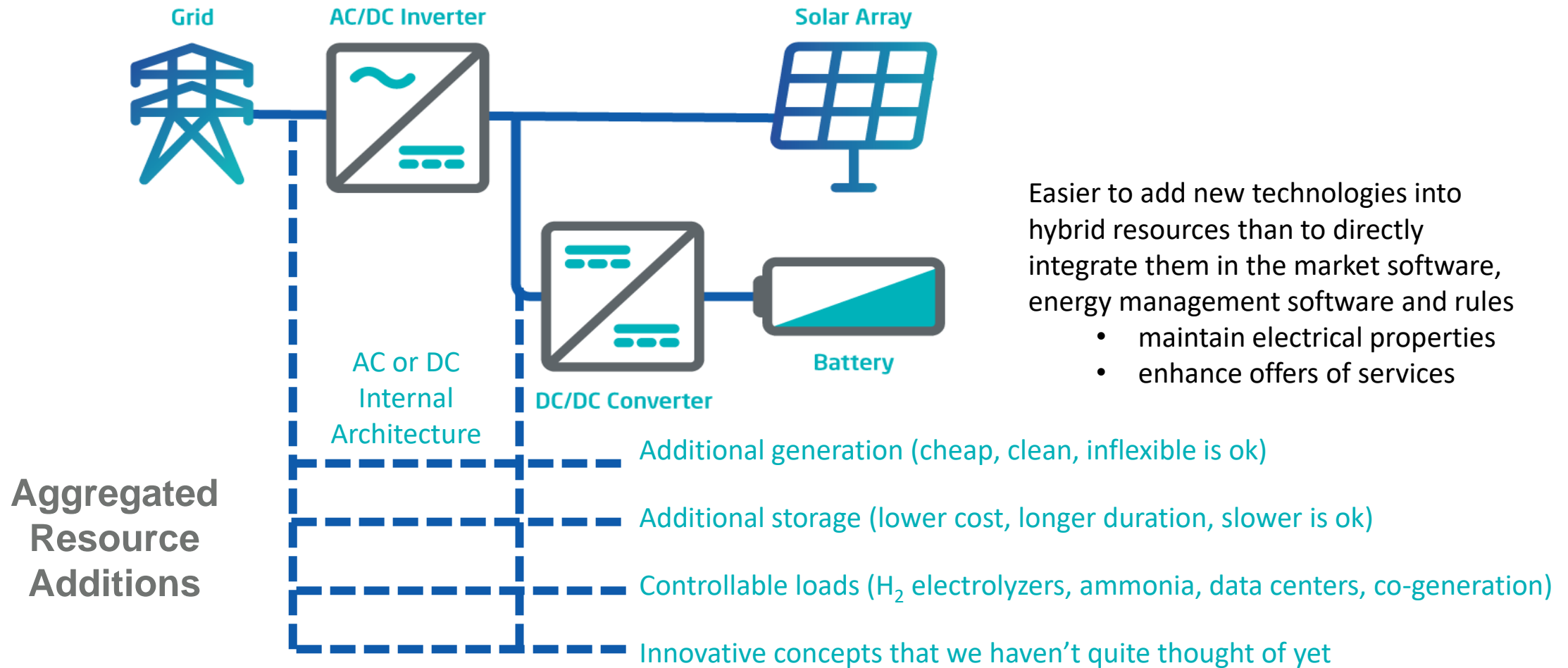
1. Tax incentives (Solar ITC applies to battery based on charging)
2. Avoided T&D upgrades (interconnection upgrades)
3. Reduced Development Costs
4. Financing (reduced long-term risk)
5. Capture DC clipping losses
6. Market design rules that limit individual resource participation
7. Simplified procurement for utility off-takers
8. Plasticity: reduce stranded investment risk
9. Land constraints

Less
Important

Objective: expert stakeholders rank and prioritize importance of each key driver
which ones are specific to hybrid vs. co-located?



What types of hybrids are we seeing?



Easier to add new technologies into hybrid resources than to directly integrate them in the market software, energy management software and rules

- maintain electrical properties
- enhance offers of services

Source: Mark Ahlstrom, ESIG, "Hybrid Resources as Power Plants The Strategic Importance of Hybrid Resources"



Hybrids Interconnection



Overbuilding the POI

an economic opportunity and a renewable + storage accelerant

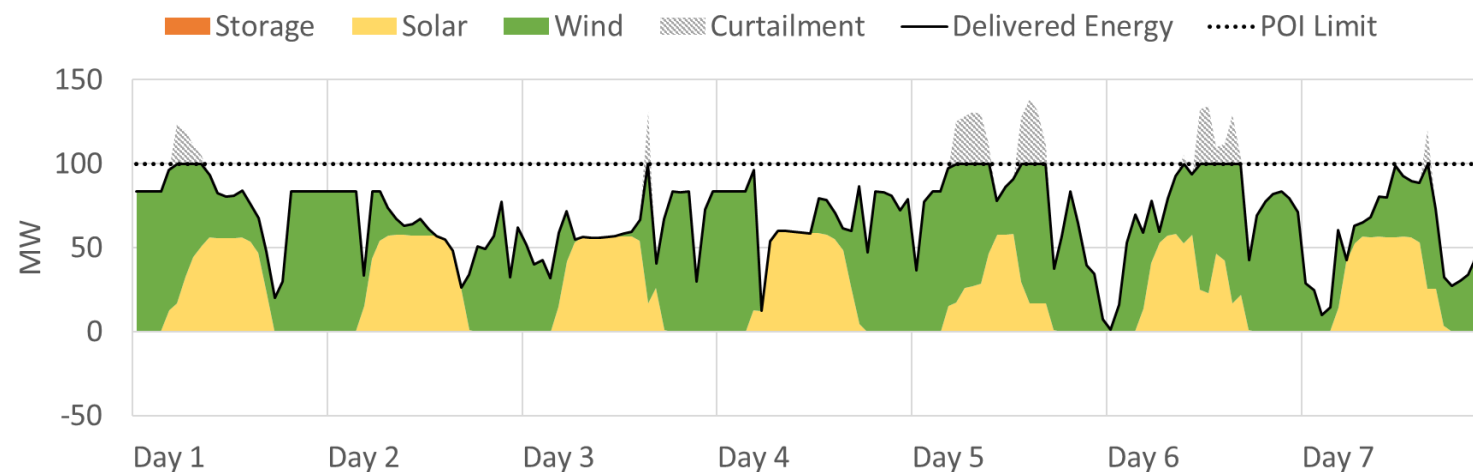
Wind + Solar Hybrid

100 MW Wind

+70 MW_{dc} PV

170 MW of resources

100 MW POI



	Wind CF	Solar CF	Hybrid CF	Curtailment
NY	32%	23%	45%	0.6%
TX	40%	34%	55%	1.4%
CA	37%	38%	53%	2.6%



Overbuilding the POI

an economic opportunity and a renewable + storage accelerant

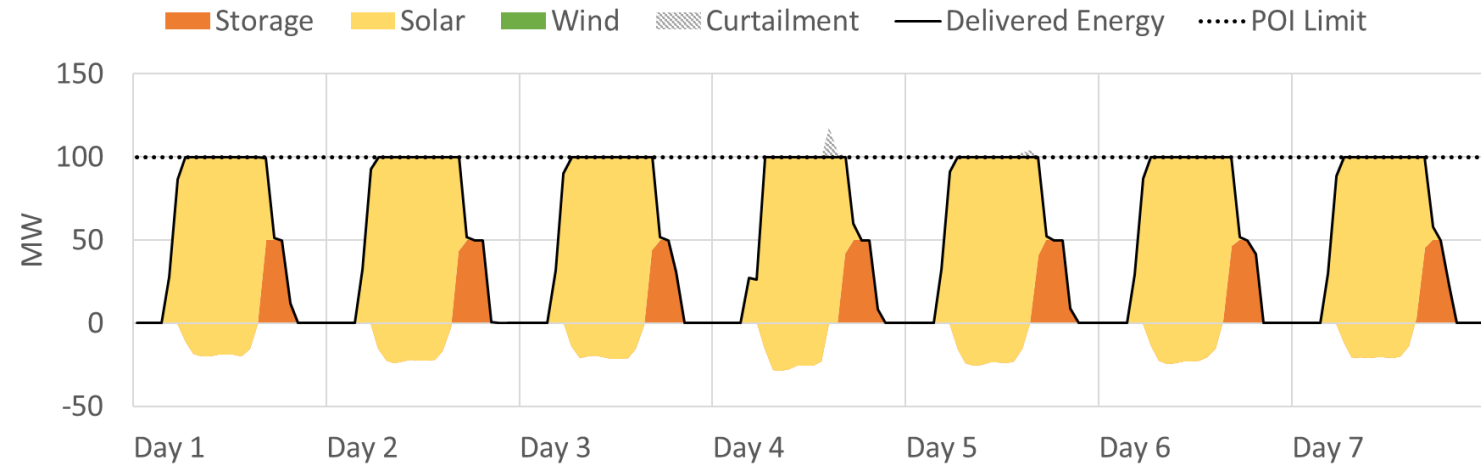
Solar + BESS Hybrid

+150 MW_{dc} PV

+ 50 MW 4hr Storage

200 MW of resources

100 MW POI



	Wind CF	Solar CF	Hybrid CF	Curtailment
NY	-	23%	25%	0.6%
TX	-	34%	35%	0.0%
CA	-	38%	40%	0.1%

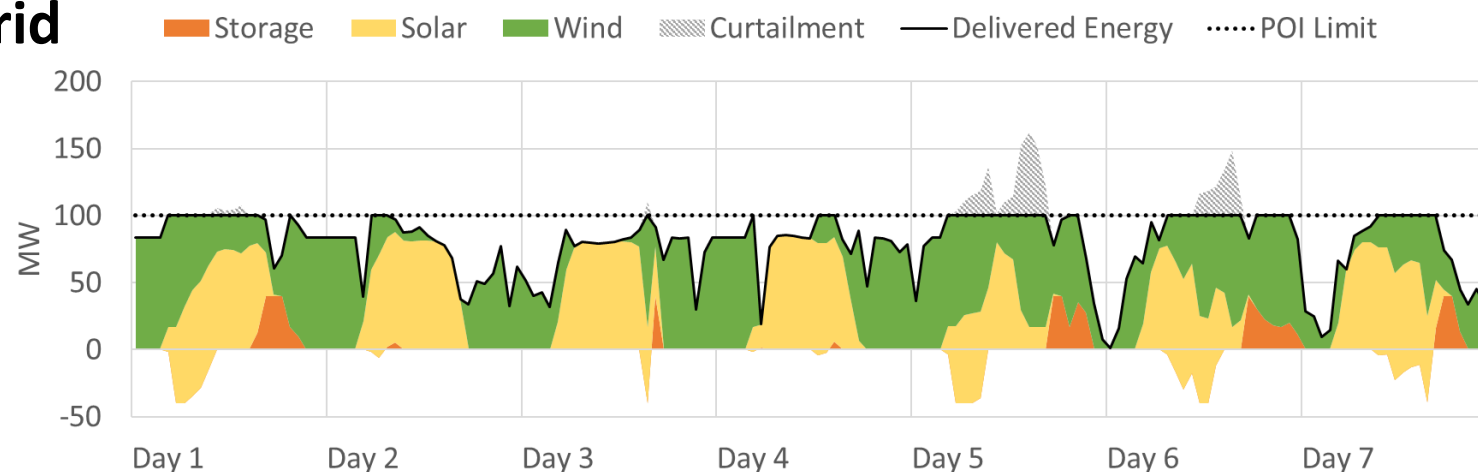


Overbuilding the POI

an economic opportunity and a renewable + storage accelerant

Wind + Solar + BESS Hybrid

100 MW Wind
+100 MW_{dc} PV
+40 MW 4hr Storage
240 MW of resources
100 MW POI



	Wind CF	Solar CF	Hybrid CF	Curtailment
NY	32%	23%	48%	1.5%
TX	40%	34%	63%	1.2%
CA	37%	38%	61%	2.6%



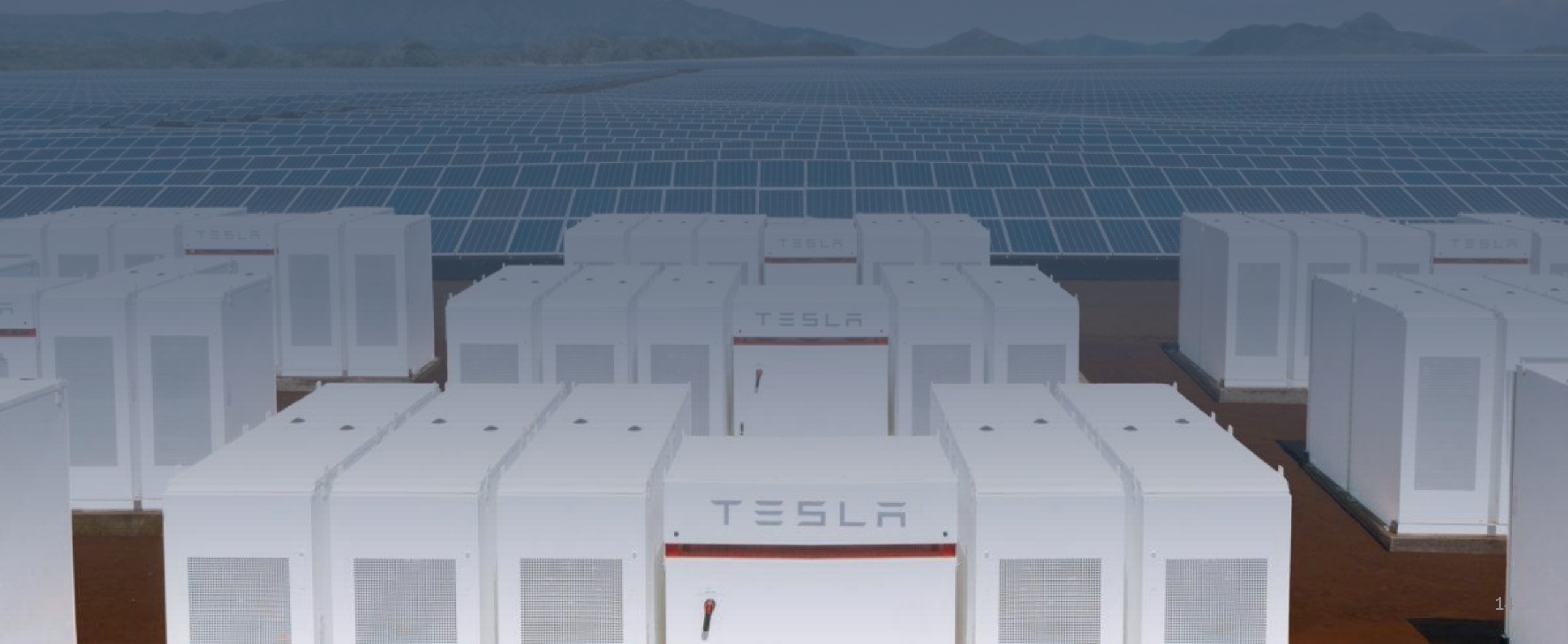
FERC Order 845

Reform of Generator Interconnection Procedures and Agreements

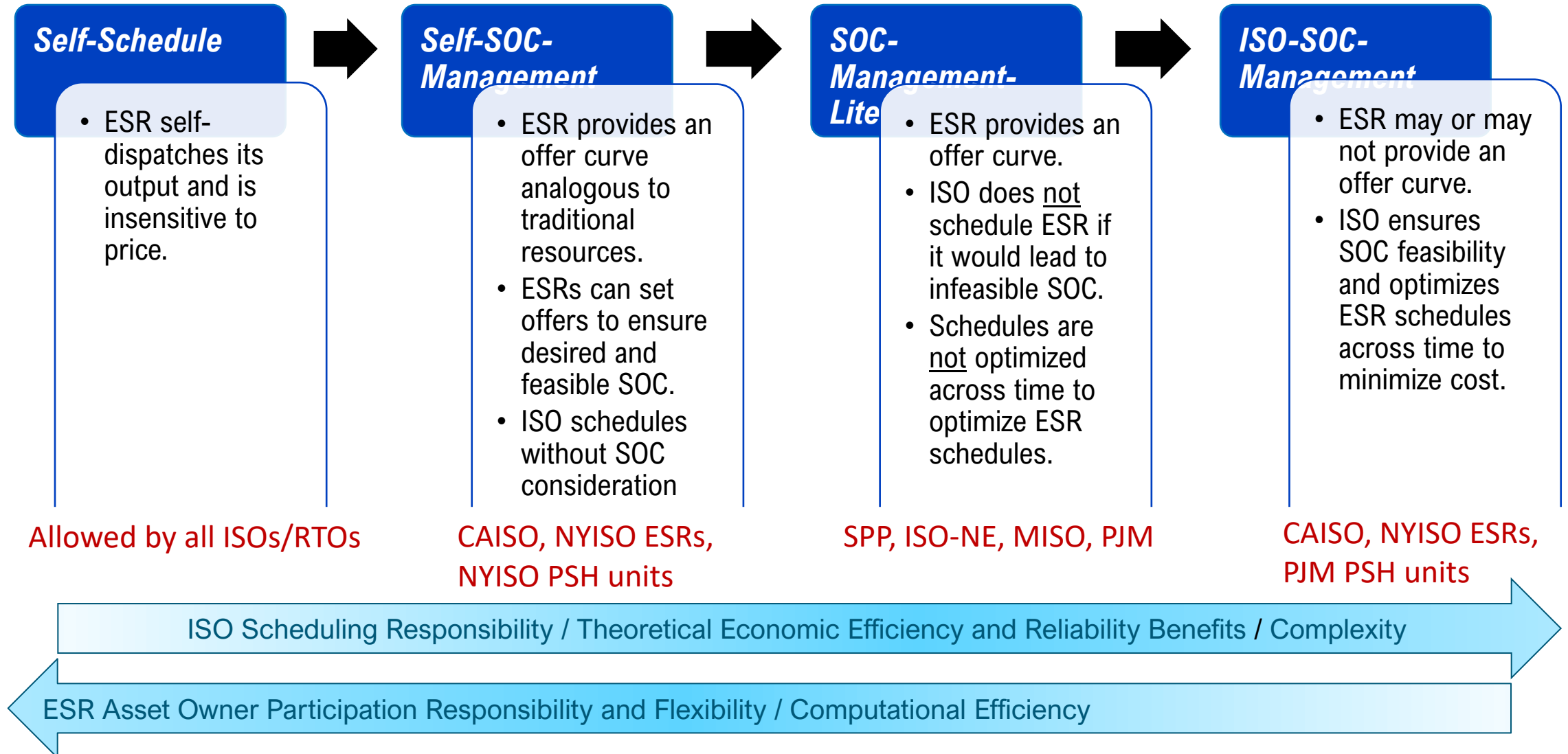
1. Request a level of interconnection service that is lower than their generating facility capability;
2. Provisional interconnection agreements that provide for limited operation of a generating facility prior to completion of the full interconnection process;
3. Use surplus interconnection service at existing points of interconnection;
4. Study an interconnection customer's technology changes without affecting the interconnection customer's queue position



Hybrid Market Participation & Operations



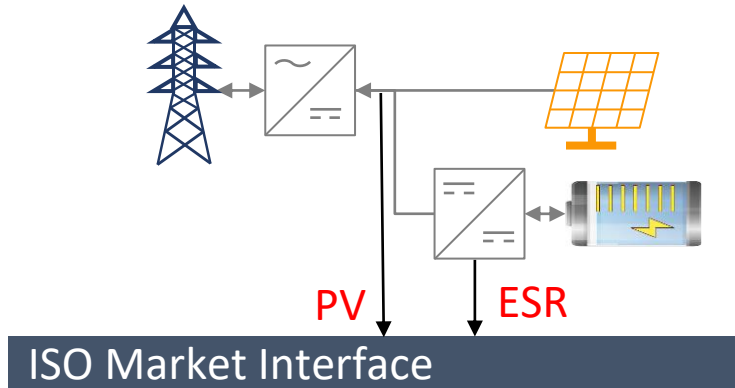
State of Charge Management: Options



Hybrid Participation Models

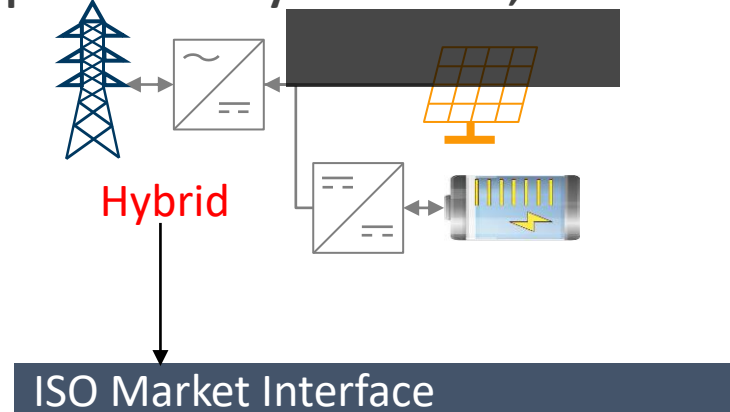
Option A: 2R Co-located Model

Separately represent each resource, with minimal changes to existing market designs



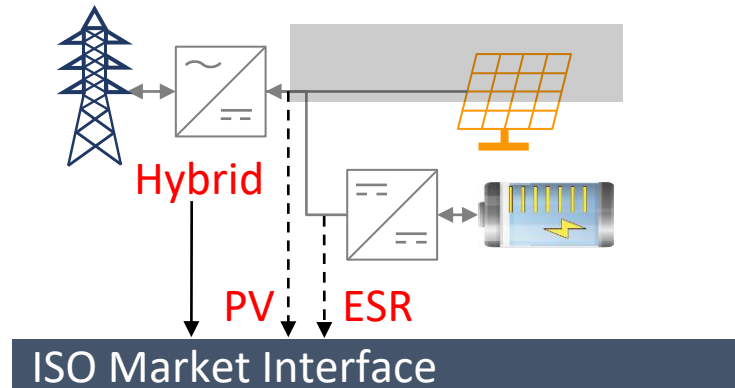
Option B: 1R Hybrid Model, Self-Management

Single offers and operating parameters allows participant bidding strategy flexibility



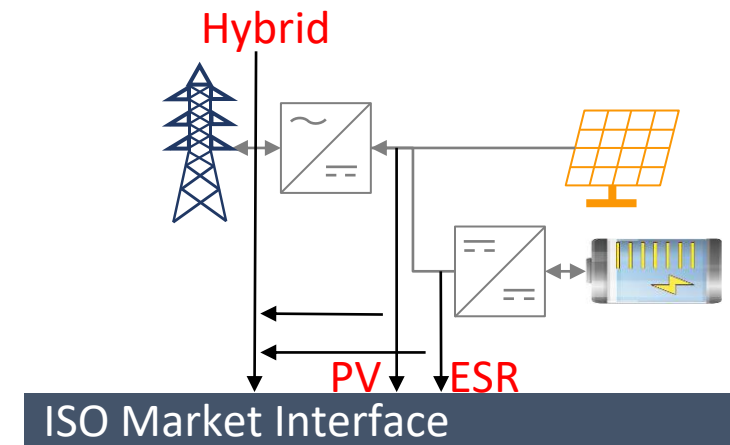
Option C: 1R Hybrid Model, ISO-Managed Feasibility

Add telemetry requirements to allow ISO to limit infeasible schedules



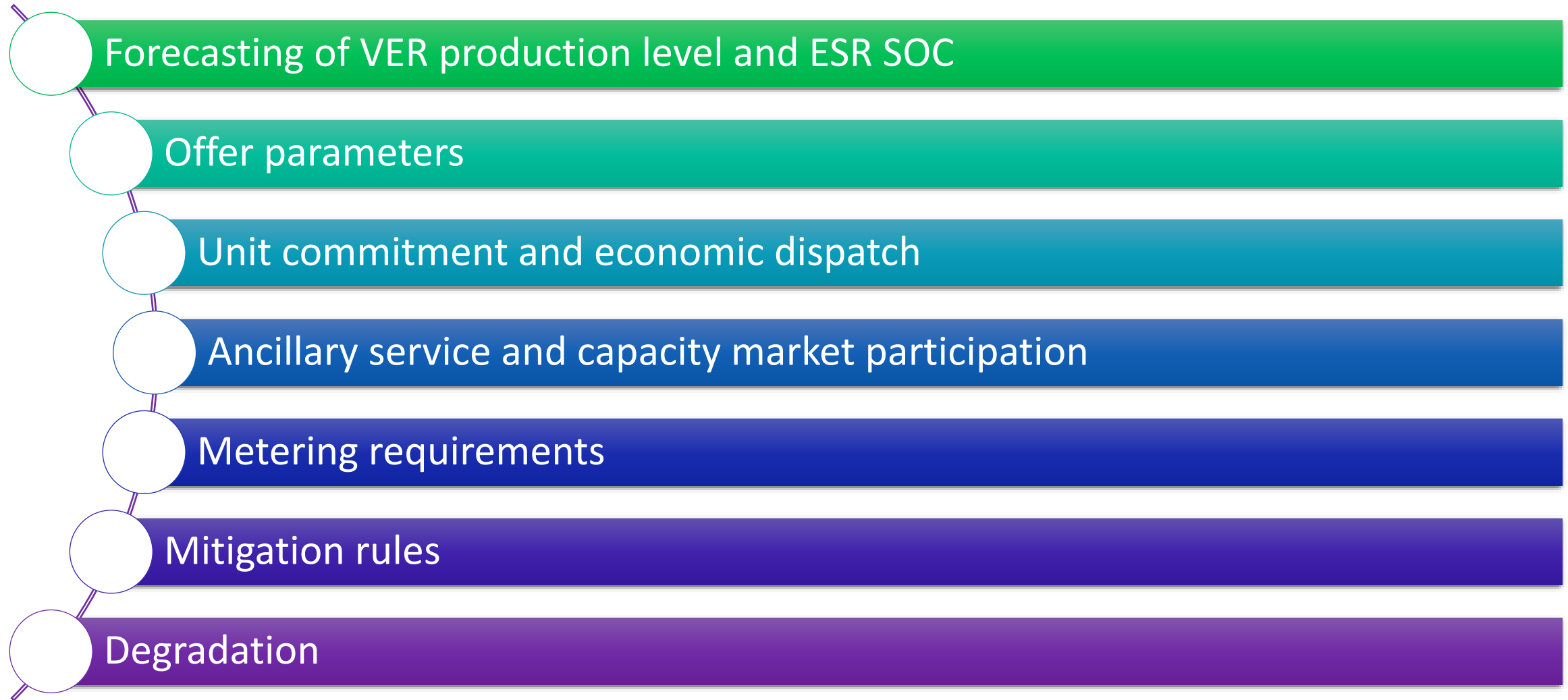
Option D: 2R Co-located Model, Linked

Add linking constraint to increase ISO's ability to operate the resource with representation of dependencies



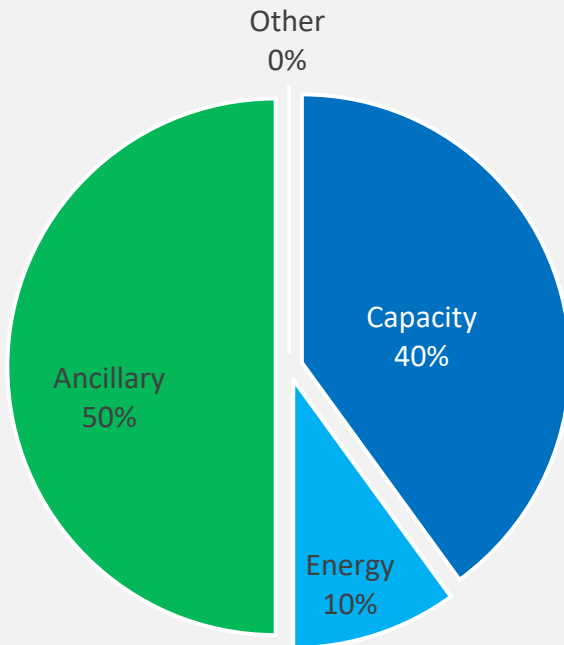
[1] Evaluation of storage plus renewable hybrid resource integration into scheduling operation. EPRI, Palo Alto, CA: 2021. 3002018648.

Key Challenges for Hybrid Participation Models



Hybrid Revenue Streams and Value Proposition will change over time

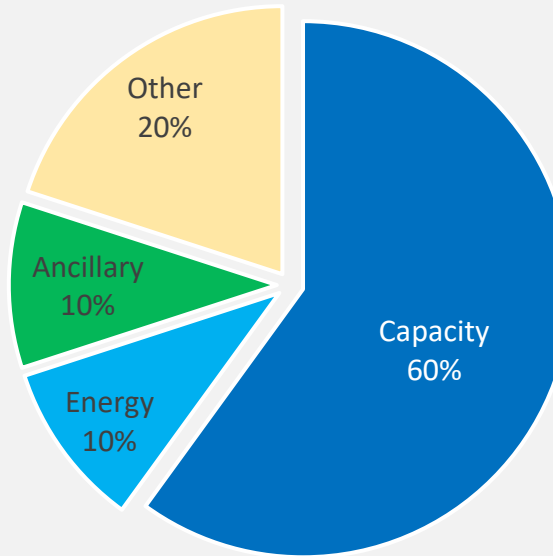
Today's Revenue Stream



Early hybrid resources will see large gains from A/S markets,

... but shallow markets will saturate quickly

Tomorrow's Revenue Stream



Capacity markets will become increasingly important,

... tightly coupled with capacity accreditation processes

other, creative value propositions will differentiate



Thank You!

Questions?



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ESIG Hybrids Task Force Next Steps

- **ESIG Fact Sheet: What, Why, and How of Hybrids**
- **Session 4: Resource adequacy & hybrid resources**
- **ESIG Whitepaper (December 2021)**



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